

# ***New Directions NASA's Airspace Operations and Safety Program***

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# Three mega-drivers have emerged that are shaping the future of aviation



Traditional measures of global demand for mobility—economic development, urbanization—are growing rapidly



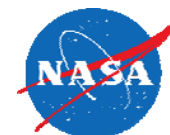
Severe energy and climate issues create enormous affordability and sustainability challenges



Revolutions in automation, information and communication technologies enable opportunity for safety critical autonomous systems



# NASA Aeronautics Research Six Strategic Thrusts



## Safe, Efficient Growth in Global Operations

- Enable full NextGen and develop technologies to substantially reduce aircraft safety risks



## Innovation in Commercial Supersonic Aircraft

- Achieve a low-boom standard



## Ultra-Efficient Commercial Vehicles

- Pioneer technologies for big leaps in efficiency and environmental performance



## Transition to Low-Carbon Propulsion

- Characterize drop-in alternative fuels and pioneer low-carbon propulsion technology



## Real-Time System-Wide Safety Assurance

- Develop an integrated prototype of a real-time safety monitoring and assurance system



## Assured Autonomy for Aviation Transformation

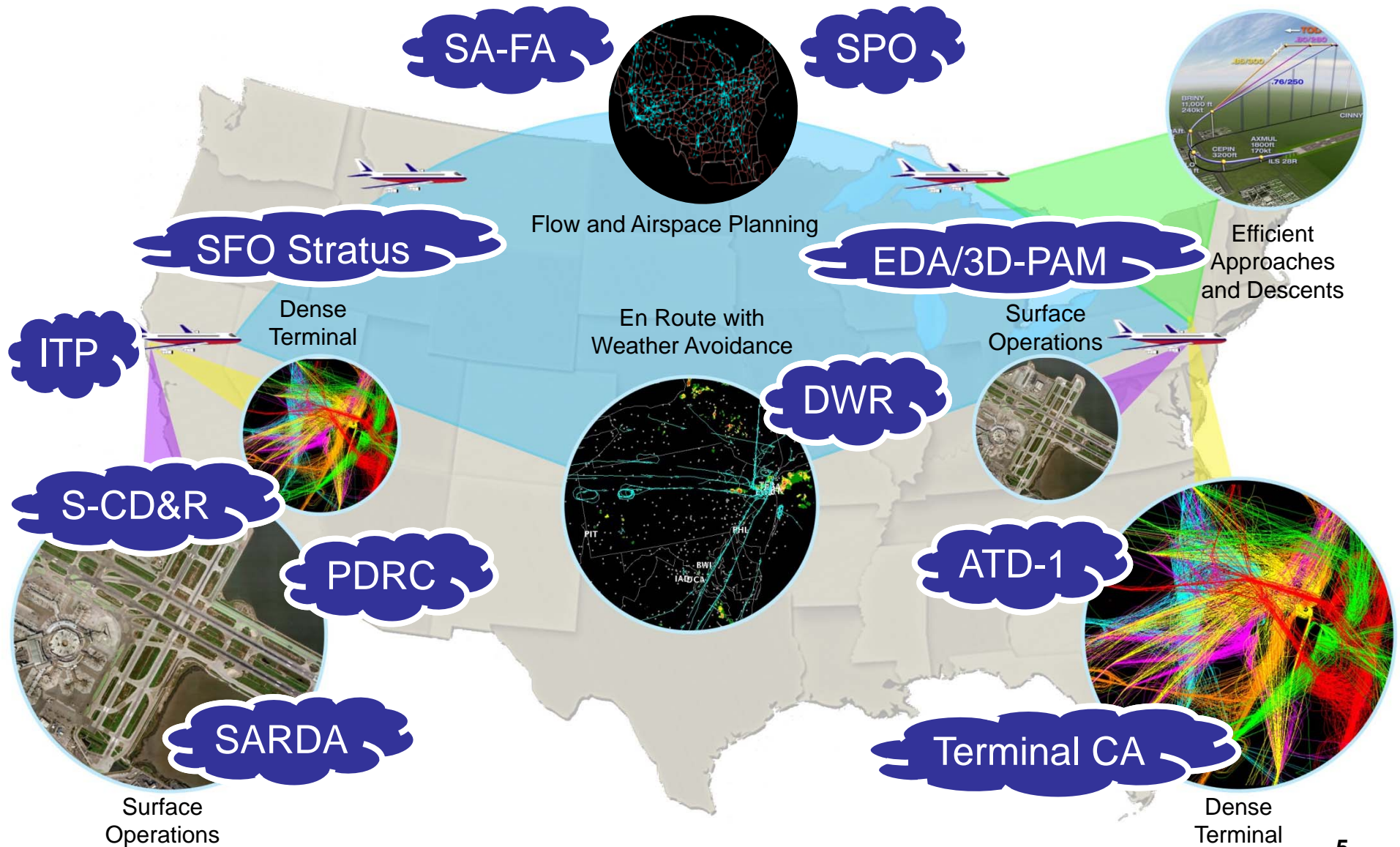
- Develop high impact aviation autonomy applications

# What is the Airspace Operations and Safety Program?

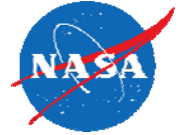
This program integrates the Airspace Systems Program and Aviation System-Safety work.



# Gate-to-Gate Concepts and Technology



# Integrated System Capability ATM Generations



## ATM +1

### *Domain-Focused Enhanced System*

Improved individual domains (e.g., surface traffic flow) with some initial integration between domains

Provides improved efficiency in each domain at the earliest possible date, supporting airline cost savings and reduction of environmental impact

Majority of current ASP research is supporting ATM +1

## ATM +2

### *Integrated Airspace System*

Integration of terminal and en route, integrated surface and arrivals/departures, and system modeling enable predictive capabilities

Provides system efficiency, predictability and reliability gains to further improve airline and ATM network operations and support traffic growth, including UAS

Some current research supports ATM +2

## ATM +3

### *System-wide Autonomous Optimized Airspace*

Dynamic, fully autonomous trajectory services enabling rapid adaption to meet user demand or respond to system perturbations (e.g., weather)

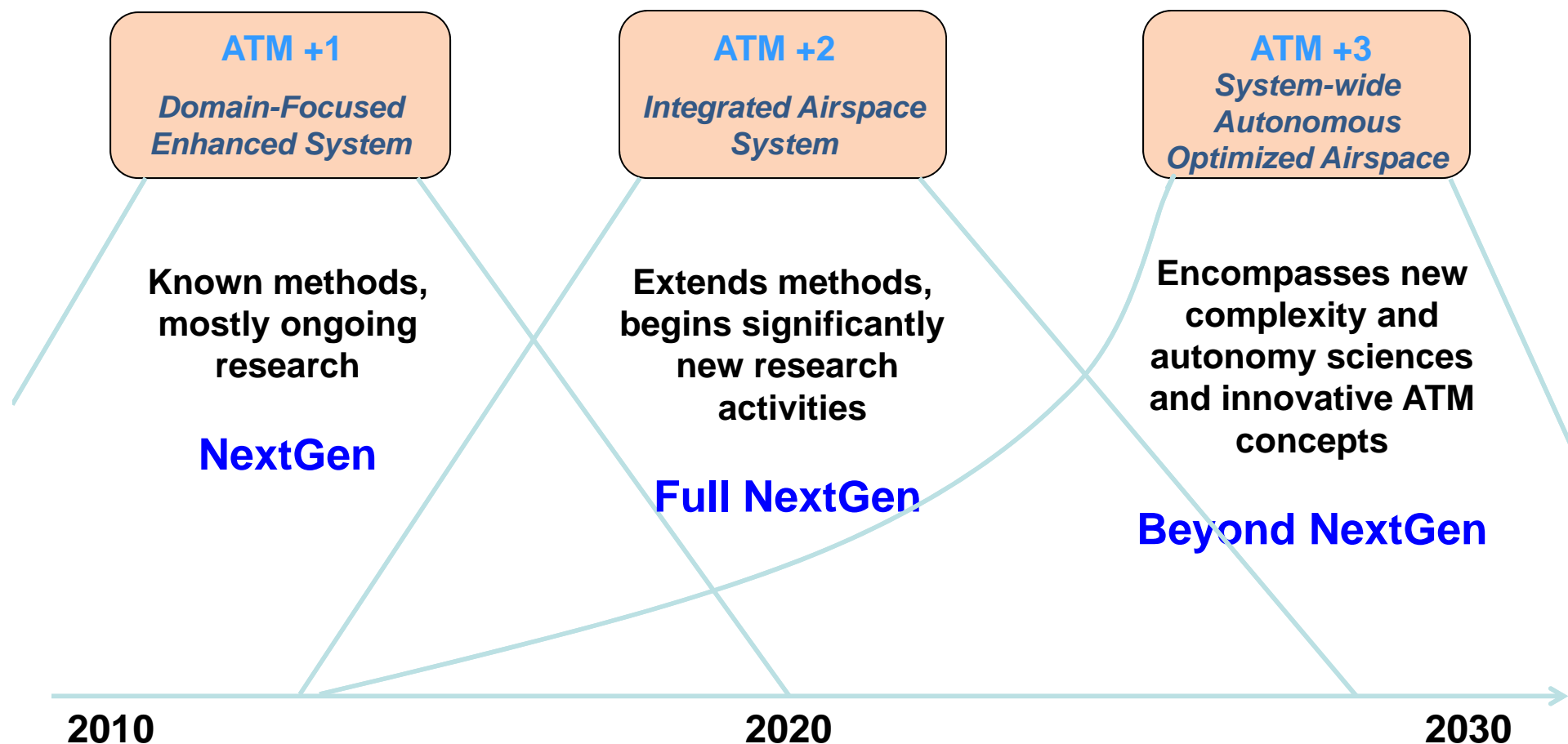
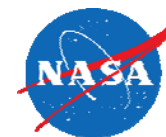
Provides a flexible, scalable, and resilient system to meet significant traffic growth and support changing operators' business-network models

This is beyond NextGen capabilities and requires the development of new concepts

Required to achieve projected 3X+ growth in traffic demand, including UAS\*

\* Demand based on JPDO IPSA analysis of FAA Terminal Area Forecast and RTCA SC-203 OSED for UAS

# ATM Generations Timeline



- ***Airspace Technology Demonstrations***
- ***SMART-NAS Test Bed for Safe, Trajectory-Based Operations***
- ***Safe, Autonomous Systems Operations***

National Aeronautics and Space Administration



# Airspace Operations and Safety Program (AOSP)

Leighton Quon  
Project Manager  
Airspace Technology Demonstration (ATD) Project

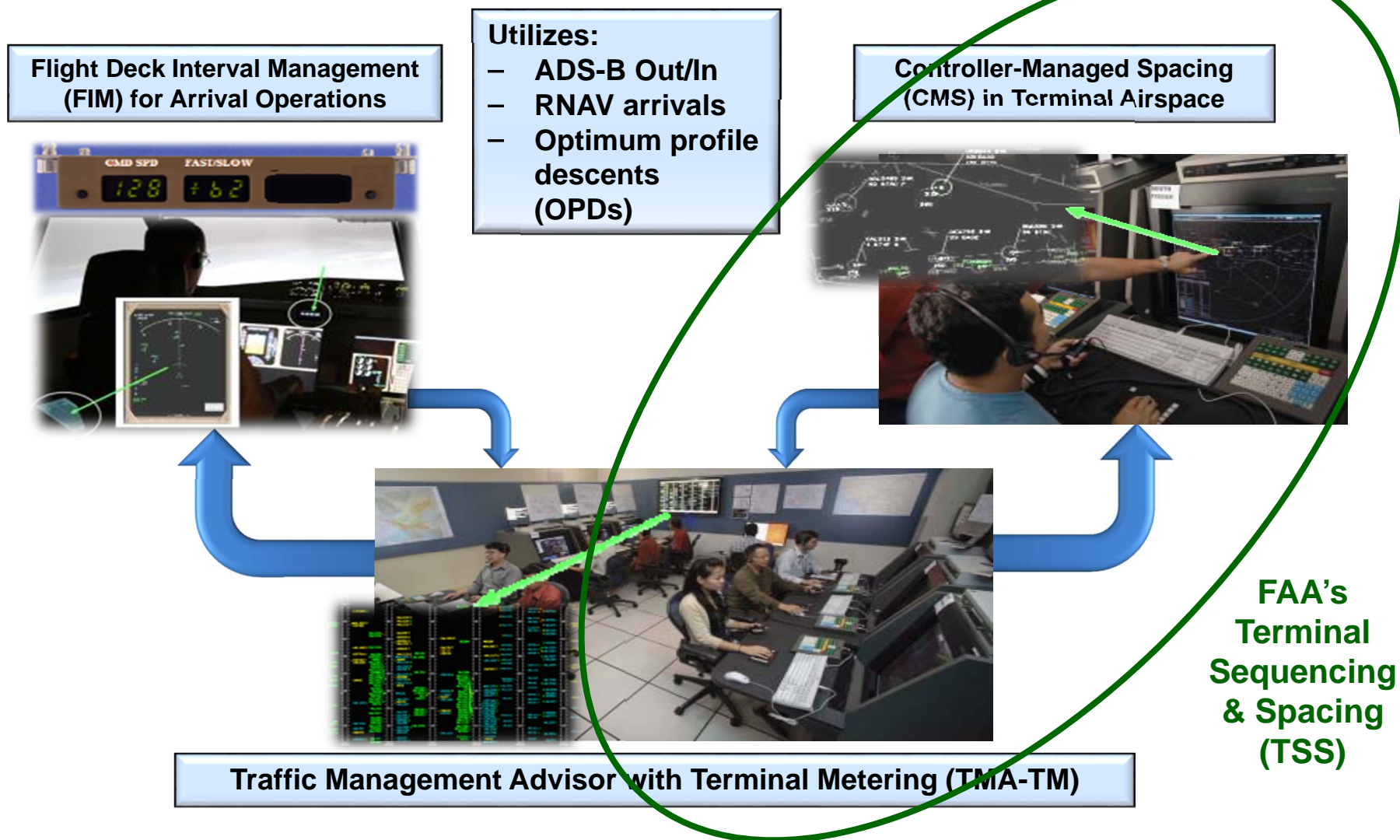
NEXTGEN





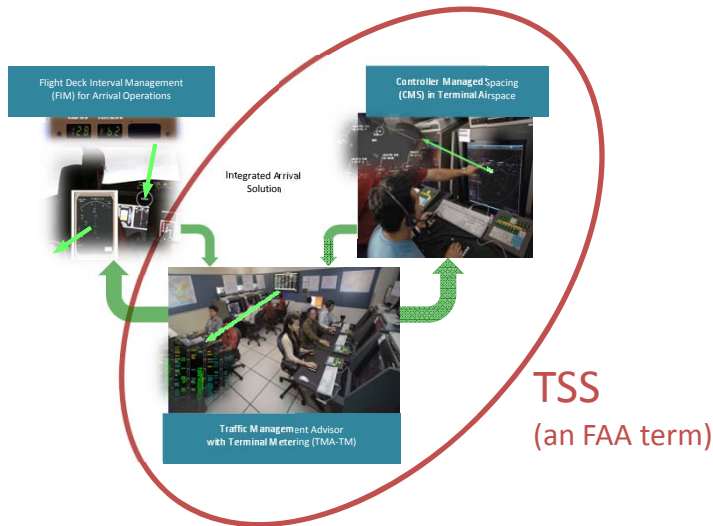
# ATM Technology Demonstration-1

**ATD-1:** Improve arrival operations efficiency while increasing arrival throughput using integrated aircraft-based and ground-based automation technologies





# ATD-1 Delivers to NextGen



- ATD-1 transferred Terminal Sequencing and Spacing (TSS) technologies to the FAA in 2013
- TSS enables use of underutilized modern avionics and Performance-Based Navigation or PBN procedures

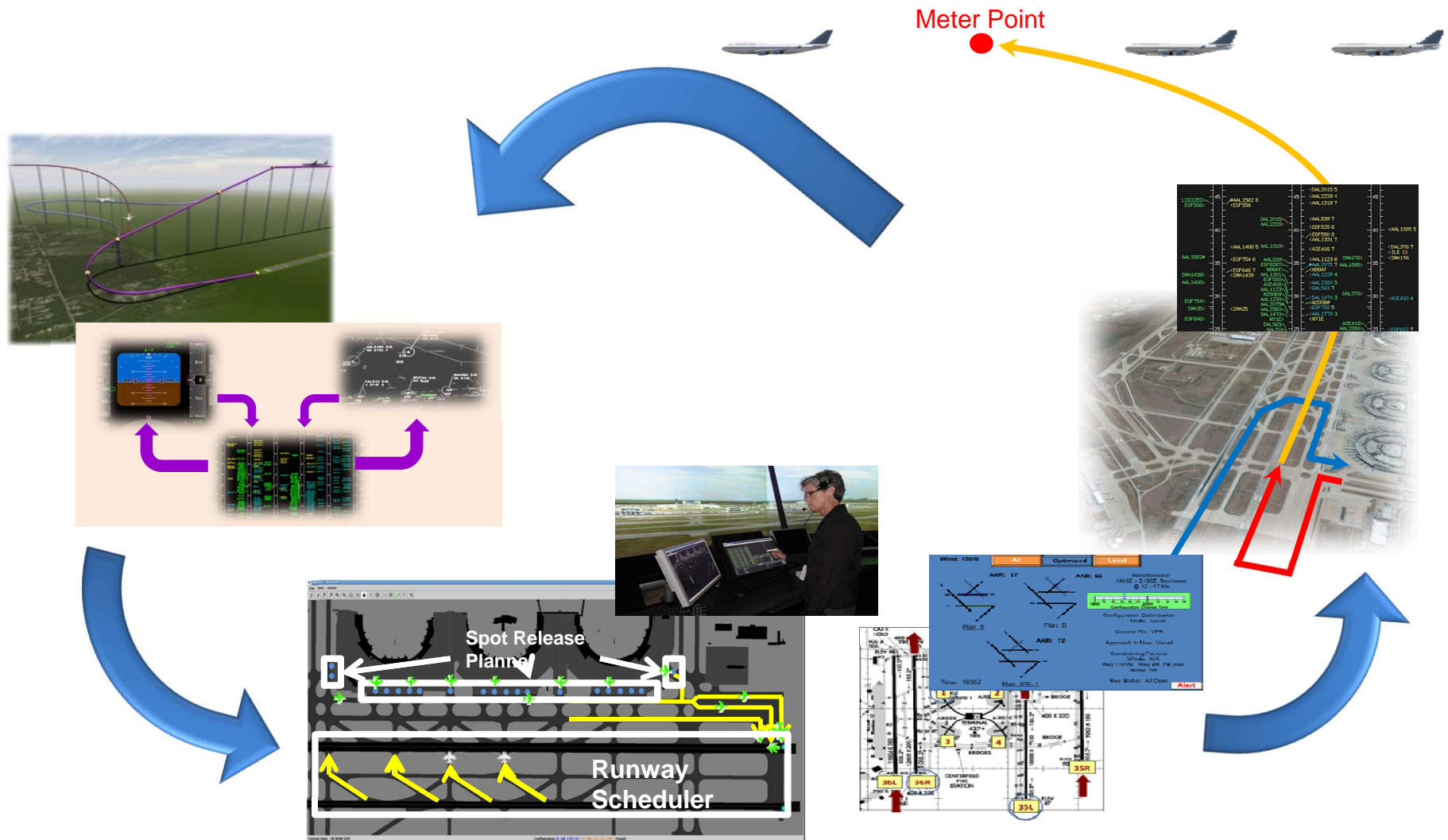
- Estimated benefit to airlines operating at 35 benchmark airports ranges from \$100-200M/year
- FAA is planning for Initial Operating Capability in 2018

**This is an unprecedented contribution of NASA technology to NextGen**

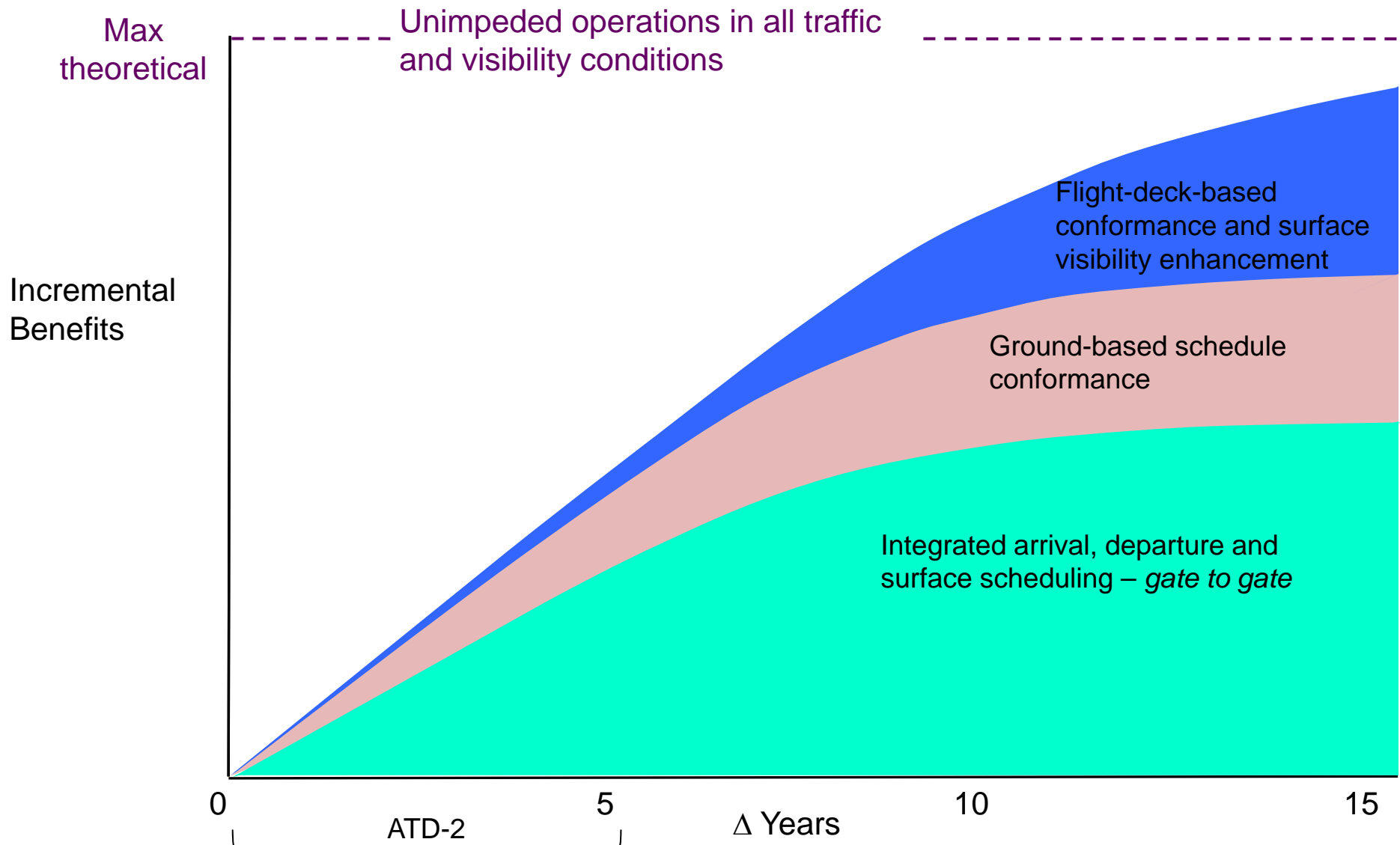
# Integrated Arrival/Departure/Surface Operations



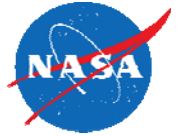
**Integrated Arrival/Departure/Surface Operations (IADS):** Simultaneously increase arrivals, departures, and surface operations efficiency while increasing overall throughput



# IADS Benefits Roadmap

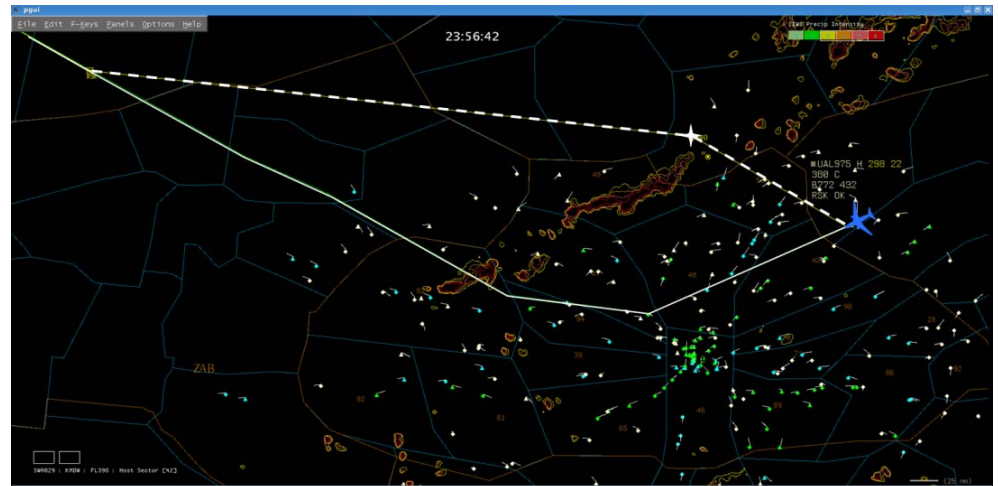


# Applied Traffic Flow Management



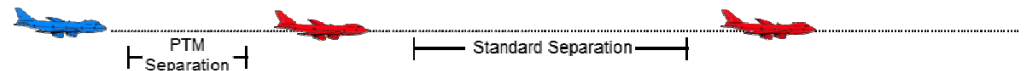
## Domestic:

- Integrated solutions are to extend NASA already developed Domestic ground/air capabilities for individual aircraft to overcome these current TFM challenges opportunistically to achieve reduced lengths of conservative re-routes, ground holds and stops, Miles-In-Trail for multiple aircraft, into web based tools
- Estimated \$79M per year nationwide savings to US airspace users

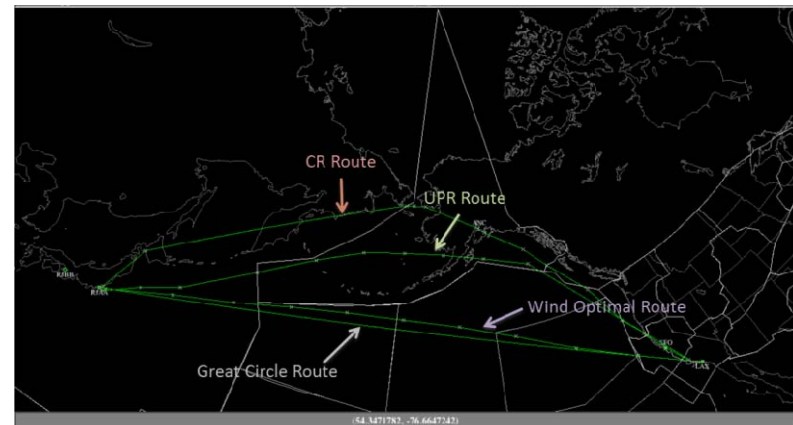
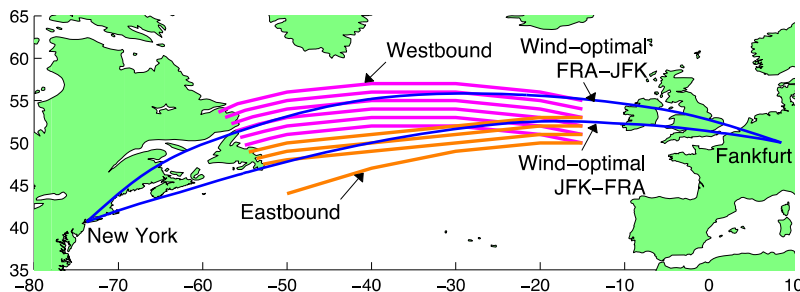


## Oceanic:

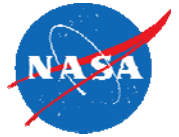
- Integrated solutions are to extend NASA already developed Oceanic capabilities for aircraft to



Pacific: 1600 lb fuel reduction per aircraft  
North Atlantic: 750 lb fuel reduction per aircraft

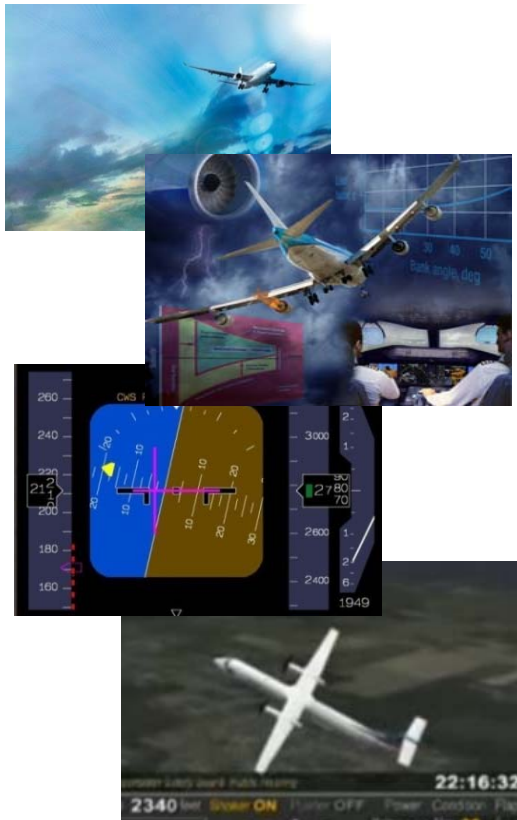


# Technologies for Assuring Safe Energy and Attitude State



- CAST's Airplane State Awareness Joint Safety Implementation Team (ASA JSIT) Recommended Research Safety Enhancements (SEs)
- NASA's precursor safety focus to *Increase Pilots' Ability To Avoid, Detect, And Recover From Adverse Events That Could Otherwise Result In Accidents/Incidents*

Cause and Effect



Safety Enhancements

